

# NovAtel

## Our Experience in the Galileo Program



ISO 9001:2000  
FM 92323



## Our Organization

- **Canadian corporation headquartered in Calgary, Alberta, Canada**
- **Established in 1983 - Initially in Telecommunications, now 100% GNSS/Precise Positioning**
- **Initial public offering in 1997 (NASDAQ: NGPS)**
- **2005 Revenues \$63.3m Cnd**
- **222 employees**



Precise thinking



## Our Technological Innovations

***"As the GPS industry transforms itself into an international positioning and information utility, NovAtel is helping to develop the core technology for these international initiatives."***

**Charles Trimble, NovAtel Board of Directors**



# SBAS & NovAtel Worldwide

## EGNOS:

Europe (2001-2002)

- 24 RIMS-C receivers (Integrity Channel)

## SNAS

China (2000-2002)

- 73 WAAS WRS receivers

## WAAS:

USA (1996-1999) 1st Generation

- 148 WRS receivers
- 21 GUS receivers

WAAS G-II Receivers

Technology Refresh (2004 2005)

- 160 WAAS G-II receivers

Geostationary Command & Control Segment (2004 2005)

- 13 L1/L5 Signal Generators
- 15 L1/L5 GUS receivers

## Key

- ▲ Wide Area Master Station
- Wide Area Reference or Earth Station
- ★ EGNOS RIMS Site

## MSAS:

Japan (1998-2003)

- 47 MSAS WRS receivers
- 6 NLES GUS receivers
- 4 UPC receivers

## GAGAN:

India (2005)

- 18 WAAS-G2 receivers
- 3 L1/L5 GUS receivers
- 3 L1/L5 Signal Generators



# NovAtel Participation in Galileo

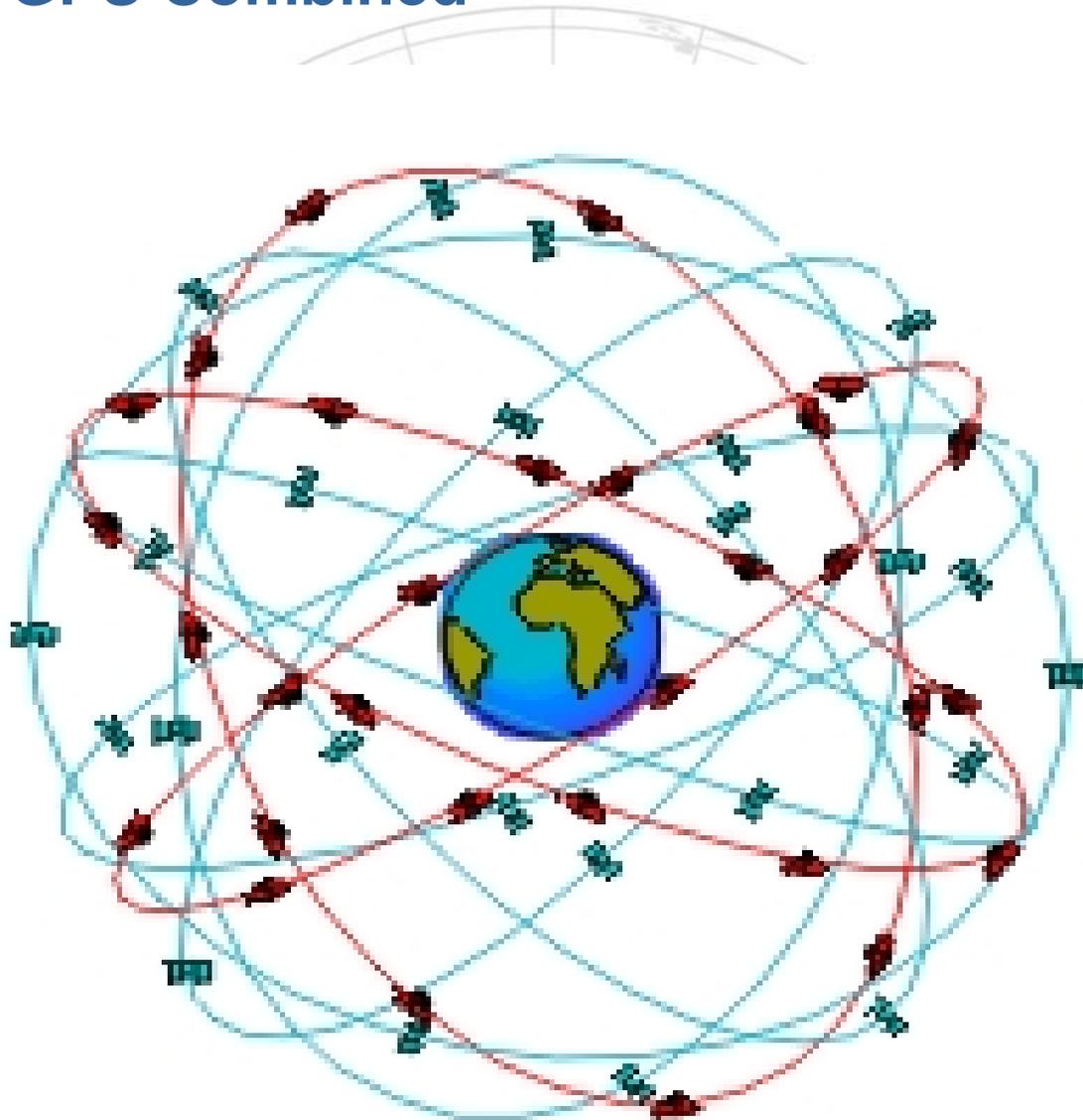


Canada

- **Canada is a participating member of the European Space Agency**
- **Canadian Space Agency (CSA) has signed an agreement with ESA to participate in elements of the European Galileo satellite navigation program**
- **CSA is the Canadian sponsor for NovAtel's participation in both EGNOS & Galileo**



# Galileo & GPS Combined



Dramatic improvements in coverage & reliability



Precise thinking

# NovAtel's Galileo Programs

- **NovAtel's has actively participated in Galileo receiver definition & development work for over five years**
- **Programs include:**
  - **Signal Validation (European Space Agency (ESA))**
  - **User Receiver Requirements (Thales Avionics)**
  - **Ground Reference Receiver (GRR) Requirements (Thales)**
  - **GPS/Galileo Interoperability (Canadian Space Agency(CSA))**
  - **GRR specification, architecture & modelling (ESA)**
  - **Three prototype receiver & transmitter development programs (CSA)**
  - **Galileo Receiver Chain (GRC) reference receiver (Alcatel Alenia Space – Italia)**



# Engineering Model L1/E5a/E5b Receiver Development

- **Space Technologies Development Program (STDP) awarded by Canadian Space Agency**
- **28 month projects**
- **Incorporates prototype receiver IP into new L1/E5a and E5a/E5b receiver in GUS receiver enclosure**
- **GPS L1/L5 Signal Generators modified to output Galileo L1/E5a/E5b signals**
- **Significant IP incorporated into Galileo Receiver Chain (GRC) reference receiver program as Background IP**



# Galileo Test /Safety of Life Receiver

- **GTR/SoL enclosure based on WAAS G-II enclosure developed for FAA WAAS System, includes:**
  - **L1/E5a and E5a/E5b Galileo, L1/L2 and L5 GPS receivers**
  - **I/O Master card for interface**
  - **power supply & cooling fans**
  - **LCD status display**
  - **Spare card slots for added frequencies, services**
  - **Developed most hardware and proto software for subsequent Galileo Receiver Chain (GRC) reference receiver**



# EuroPak- 15a Receiver

- Dual frequency (L1/L5E5a) receiver card from GTR
- Dual mode EuroPak receiver – tracks both Galileo L1/E5a & GPS L1/L5.
- Tracks 16 channels with user selectable configurations:



	GPS L1	GPS L5	GEO L1	GEO L5	Galileo L1	Galileo E5a
Config1	8		4	4		
Config2	6	6	2	2		
Config3	8	8				
Config4	6				5	5
Config5					8	8



# TRT GSVF Galileo Simulator Testing

- **Galileo Signal Validation Facility**
  - Located at ESA-ESTEC in Noordwijk, Holland
  - Simulator supplied by Thales Research and Technology (TRT)
- **Full constellation RF simulator**
  - L1, E6, E5 (including AltBOC)
- **NovAtel 15a receiver compatibility confirmed in testing with TRT simulator September 2005 & May 2006**



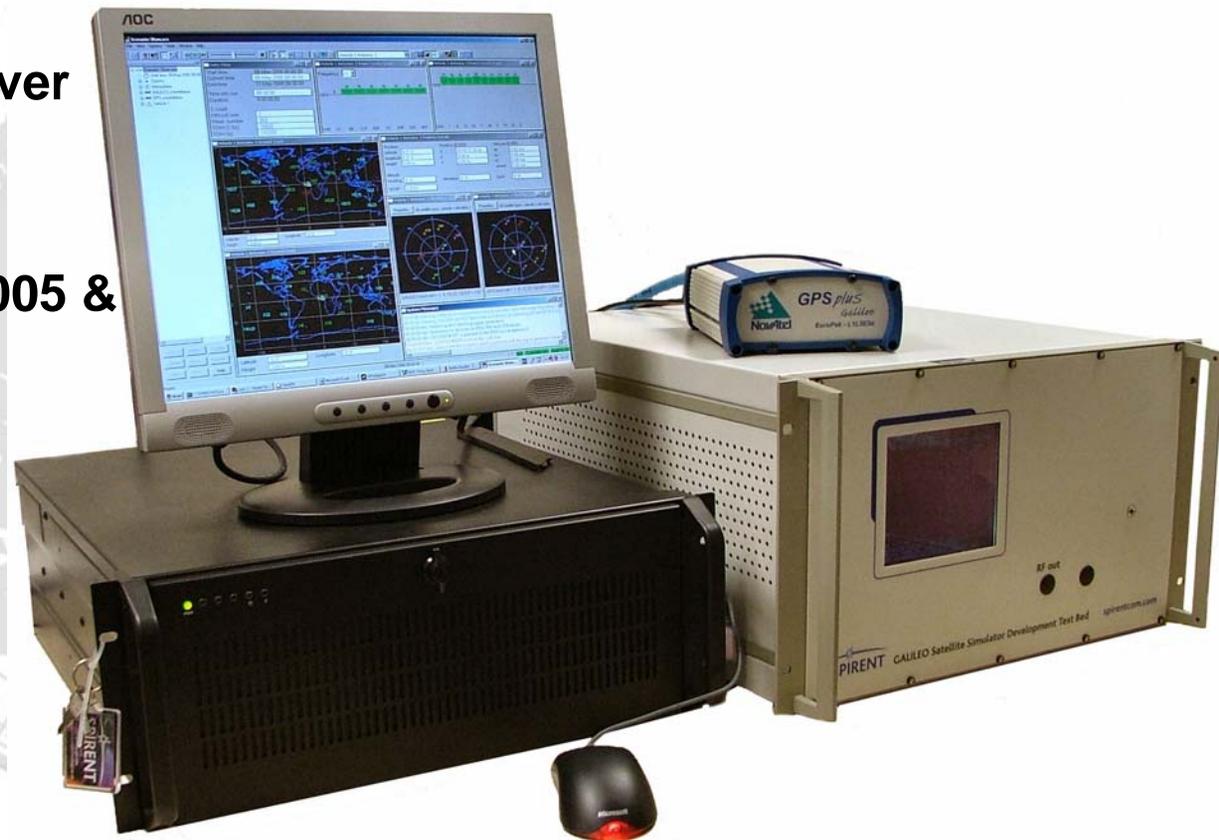
Photo courtesy Thales Research and Technology



Precise thinking

# Spirent Galileo Simulator Testing

- Spirent 7800 Full Constellation/Service Simulator selected for Galileo development support
- EuroPak-15a receiver used in Spirent development
- Integrated in Q4 2005 & ongoing in 2006

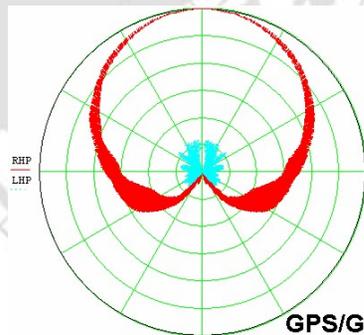


Precise thinking

Photo courtesy Spirent Communications

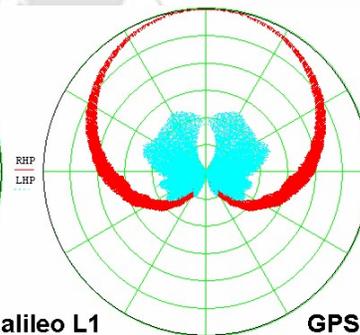
# GNSS Wideband Antenna

- Receives GPS L1/L2/L5, Galileo L1/E5a&b/E6, GLONASS L1/L2 and L-Band
- Requires external LNA



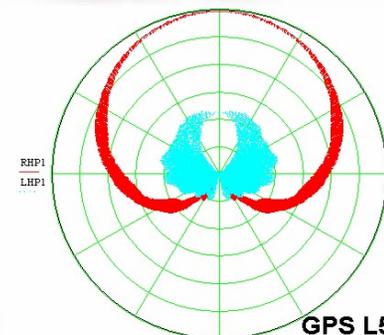
**GPS/Galileo L1**

Peak Gain = +6.0 dBic  
Amplitude Roll-off = -13 to -15 dB  
Scale = 5 dB/Ring



**GPS L2**

Peak Gain = +2.5 dBic  
Amplitude Roll-off = -10 to -  
Scale = 5 dB/Ring



**GPS L5/Galileo E5a**

Peak Gain = +2.0 dBic  
Amplitude Roll-off = -10 to -12 dB  
Scale = 5 dB/Ring

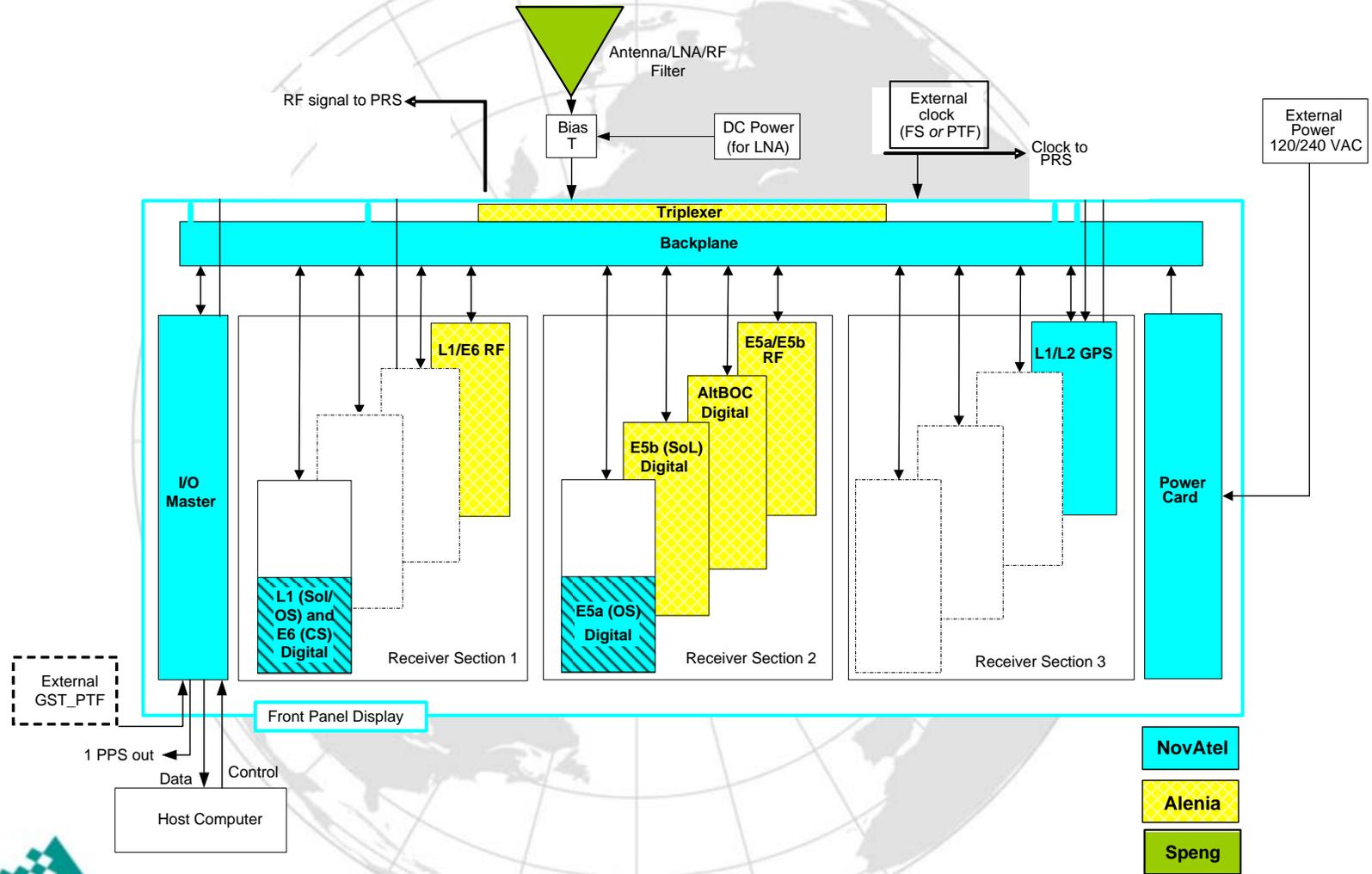


## Galileo Receiver Chain (GRC) receiver

- **Reference receiver for Galileo Ground Control System**
- **All frequencies and services except Public Regulated Service (PRS)**
- **Team of Alcatel Alenia Space – Italy & NovAtel, Space Engineering (Italy) supplies the reference antenna**
- **Program Kick-off - June 30, 2005**
- **System Requirements Review (SRR) – 8/9 Sept 05**
- **Preliminary Design Review (PDR) – Jan-June 06**
- **25 GRC receivers to be delivered Q4 07 thru Q2 08**
- **Contract negotiations underway**



# Galileo Receiver Chain (GRC) receiver block diagram



Precise thinking

## Galileo License

- **NovAtel had early Galileo ICD access as a bidder and program participant under NDA**
- **Receiver programs underway only allow use of ICD directly for European Galileo programs**
- **Current dual mode commercial GPS/Galileo products cannot be sold without a 'License' - per published ICD copyright restrictions**
- **No license currently available to NovAtel**
- **Other European players also concerned by lack of progress on licensing**
- **License process may not be in place before Galileo Concession award**



## Galileo License (cont)

- **NovAtel's preference is for a 'level playing field' on Galileo technology and licenses with open, published specs without charge**
- **NovAtel does not want to sign up to a paid license while other parts of the world may make & sell receivers without payment - how this will be policed?**
- **G8 countries with recognized international legal systems may be able to manage & administer cross-border licensing arrangements – what about the rest of the world?**
- **WG-B should help establish the ground rules for licenses, ensure an equitable, world-wide process**



[www.novatel.com](http://www.novatel.com)

Questions?



ISO 9001:2000  
FM 92323



Precise thinking